Status of FPIX Production

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Outline

- Flow Chart of Detector Assembly
- Detector Assembly Status
  - VHDI
  - Plaquette/Panel Testing
  - Panels
  - Half-Disk Assembly
  - Final Assembly
- Summary

Flow Chart of Production Assembly

Plaquette Production

VHDI Lamination on silicon
Populate VHDI with capacitors
Dice VHDI sheet

↓

Probe testing of VHDI (@KSU)

↓

Build Plaquette from Bump-Bonded Sensors/ROC, &VHDI) & Quick Test (WBS 5.3.1--Purdue)

↓

Burn-in of Plaquette

↓

Plaquette Qualification Test

Panel Production

HDI Lamination onto Be

↓

Probe testing of HDI

↓

Populate with capacitors
Install wires,TBM etc
"Bare Panel"

↓

Burn-in TBM& Panel

↓

Install Plaquettes on Panel

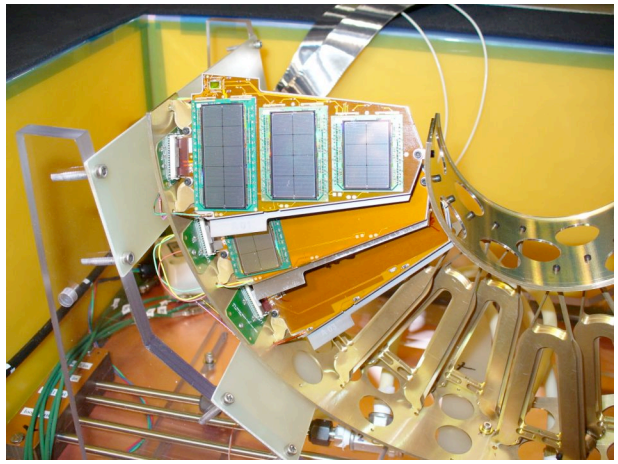
↓

Wire Bond Plaquettes

↓

Panel Qualification Test

We are up to here with production parts



Final Detector Assembly

Assemble Cooling Channels into Half-Disks

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Mount Panels on Half-Disks

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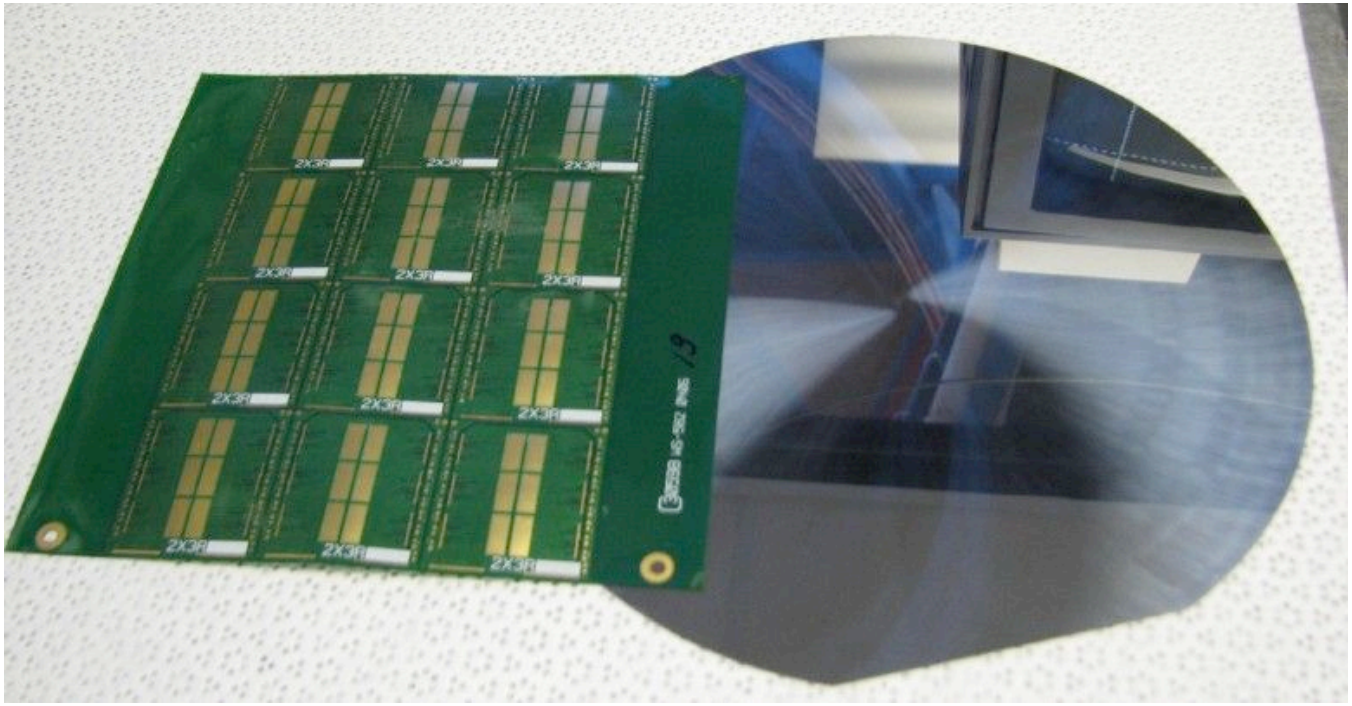
Mount Half-Disks & Electronics on 1/2 Service Cylinder

VHDI Production



- Flex circuit laminated to 300μ Si Wafer with 3M9882 (50 μ thick) Thermally Conductive Adhesive Tape
- Probe Tested at KSU for electrical faults
- We were working out Lamination Issues at time of last PMG
  - Now solved

VHDI Production Status

VHDI Ttype	Shipped to KSU	Needed (25%spare)	KSU Good	KSU Bad	Total KSU Tested	KSU Test Yields	Remaining Shipped to be tested	%tested/shipped
1x2L	63	60	60	1	61	0.98	2	0.97
1x2R	87	60	72	8	80	0.90	7	0.92
1x5L	57	60	53	4	57	0.93	0	1.00
1x5R	79	60	74	2	76	0.97	3	0.96
2x3	310	240	167	23	190	0.88	120	0.61
2x4	287	240	187	21	208	0.90	79	0.72
2x5	182	120	114	10	124	0.92	58	0.68
Plaquette Total	**1065**	**840**	**727**	**69**	**796**		**269**	**0.75**
ROC Equivalent	**6956**	**5400**	**4537**	**454**	**4991**		**1965**	**0.72**

last updated
9/25/06

- Using KSU Probe Testing Yields, we will need to order a few more sheets of VHDI's to cover our spare plaquette needs.
- ok for now

Production Plaquette Testing

(FNAL, NU, UNL, UVa, Purdue-Calumet, SUNY-Buffalo)

- Plaquettes arrive from Purdue
  - Where they have already passed a quick functionality test
  - We make a“Very Quick Test” as they are unpacked at SiDet
- Immediately loaded into Burn-In Test
  - Temperature is cycled a 10 times between 20^{o}C and -15^{o}C over 2 day period
  - Modest testing
    - Multiplex through all 20 plaquettes, simply counting ultra-blacks, perhaps an occasional pixel-alive test.
    - Will note time if a plaquette fails
- All plaquettes which have not obviously failed during the burn-in then undergo a Full Plaquette Characterization Test (slide after next)

Plaquette Testing- Burn-In Box

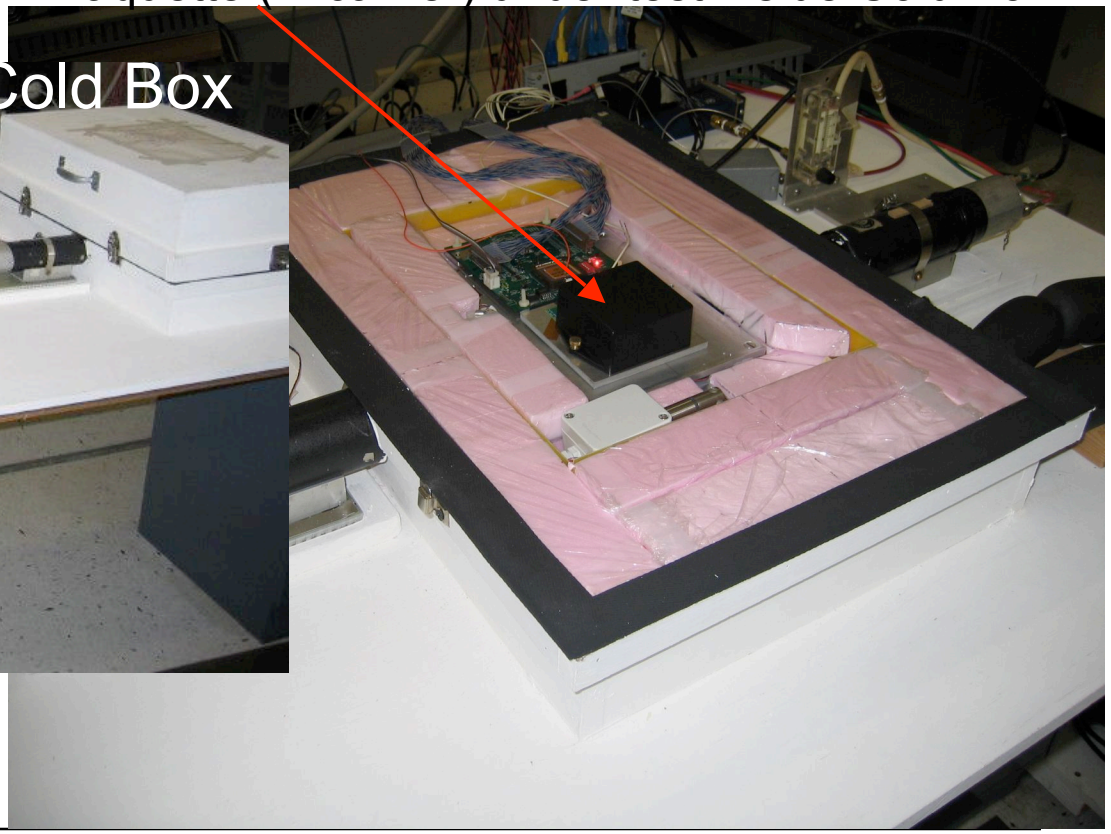
- Each shelf can hold:
  - 2 Plaquette Carriers for 20 in total
  - 1 Panel carrier
    - for 10 Panels in total
  - Current Setup
    - 7 Plaquette, 3 Panel Shelves
- 10 Temp cycles between ~20<->-15^{o}C
  - 2 day period
  - LV and HV on
  - Modest testing runs continuously
- Currently in production
  - >160 plaquettes have been processed
  - No plaquette has yet failed during the burn-in
- Weekly rate (3 runs) 42 Plaquettes, 9 Panels

Plaquette/Panel Testing

- 2 test Stations for Plaquettes (8 Plaquettes/day)
- 1 test Station for Panels (2 Full Panels/Day)
- Easily handles full Purdue Production rate (6 Plaquettes/day)

PTA Test Stand

Plaquette (in carrier) under test inside Cold Box



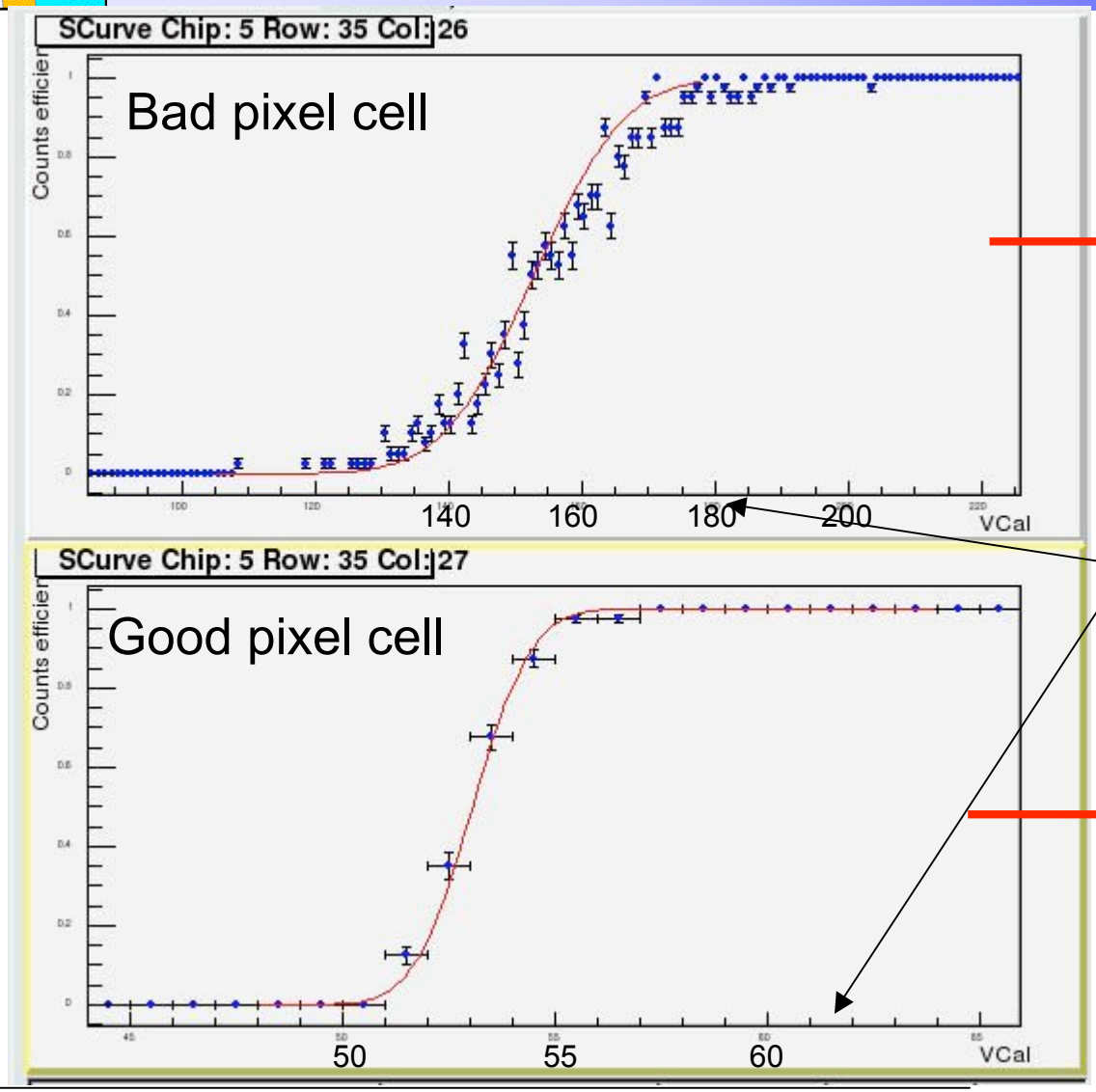
Production Plaquette Testing Plan

- Full Plaquette Characterization Tests at -15^{o} C
  - Test Assumptions:
    - Want to verifiy that Plaquette works acceptably for mounting onto Panel
    - Do not need to provide final calibration of threshold trimming, Pixel Charge, or address levels
      - Assume calibration will be handled downstream by Calibration Group
- Plaquette Grading Scheme
  - "A": basically a "perfect" plaquette which is qualified to be mounted on a panel
  - "B": a plaquette with minor issues
    - >0.5% bad pixels in a single ROC (primarily bad bumps) ("B^{+}" to "A^{-}")
    - DAC settings >4σ of mean of all plaquettes
    - A "B" plaquette may be mounted on a panel after more deliberations
      - e.g. if only one ROC fails the bad pixel levels
  - "C": a plaquette with major issues that will not be mounted on a panel
      - e.g. a completely dead ROC or massive #'s of bad bumps, or other issues

First 160 Production Plaquette Test Results

- 76 “A” (29 IZM, 47 RTI)
- 46 “B” (20 IZM, 26 RTI)
  - 8 have pixel “issues” <0.5% (“A^-”) (all RTI)
  - 7 have pixel “issues” <1.0% or slightly marginal HV (“B^+”) (4RTI, 3 IZM)
  - 18 have pixel “issues” < 2.5% (“B”) (7RTI, 11 IZM)
  - 6 have total pixel “issues” <5% (“B^-”) (2 RTI, 4 IZM)
  - 7 have “more”marginal HV--need further discussion (4 RTI, 3 IZM)
- 38 “C” (32 IZM, 6RTI)
  - 27 of the 38 “C” graded plaquettes are due to a bad IZM processing step
    - Problem exhibited by low gains/high noise in many pixels in specific ROCS
    - Noticed these ROCs were came from the same geographic region of the wafer.
    - Verified effect with movable pulse Laser aimed into Sensor cells
    - 5 have breakdown issues (3 RTI, 2 IZM)
  - 2 have hundreds missing bumps (all RTI)
  - Remainder are miscellaneous problems in ROC’s
- B grades are currently under active discussions!
  - RTI pixel issues are all missing bumps
  - IZM pixel Issues are IZM effect.

"IZM Effect": Comparison of a good and bad cell of chip5. Fix threshold, scan Vcal



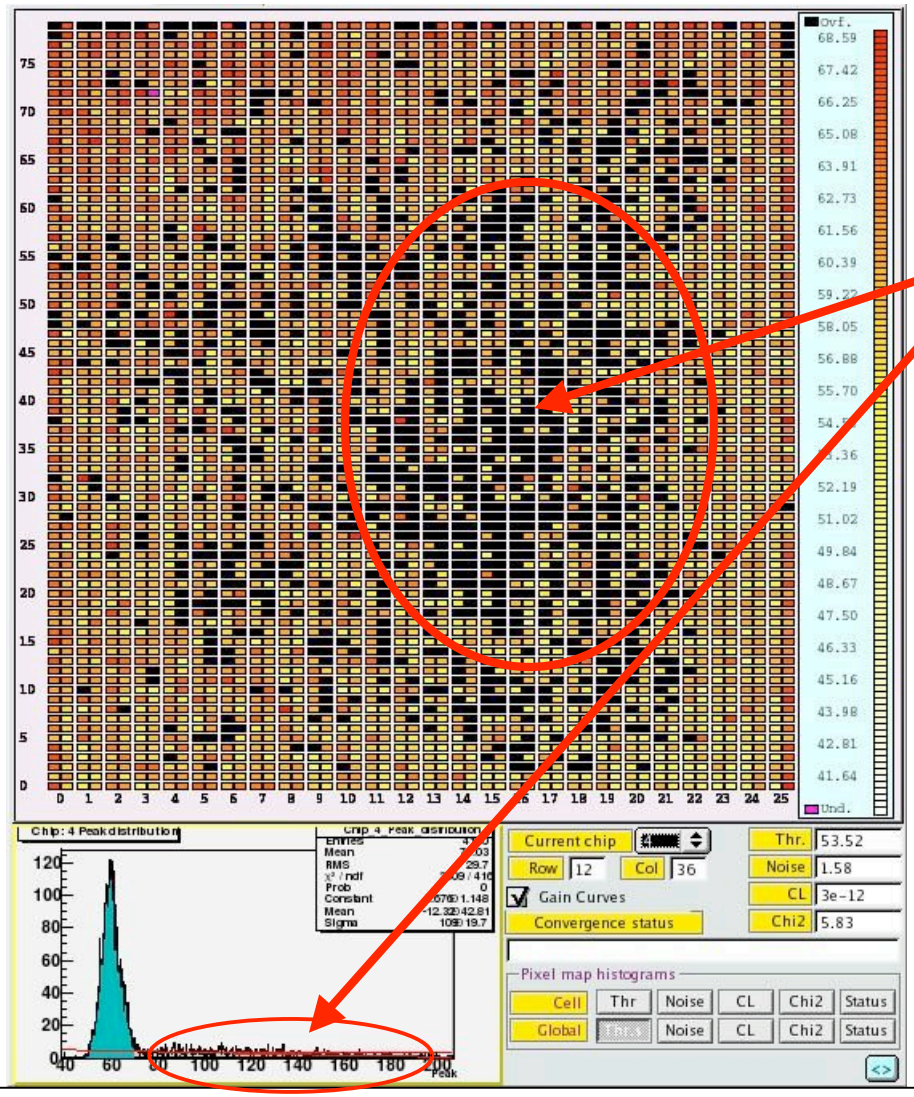
Vcal is a ROC built-in calibration signal. Vcal unit ~60e⁻

Threshold = 9600 e⁻
Noise = 500 e⁻

Note x-axis scales are different!

Threshold = 3200 e⁻
Noise = 100 e⁻

Threshold dispersion of chip4,
Fix Common Threshold @~50 Vcal units for entire chip, scan Vcal



Vcal is a ROC built-in calibration signal.
Vcal unit ~60e$^-$

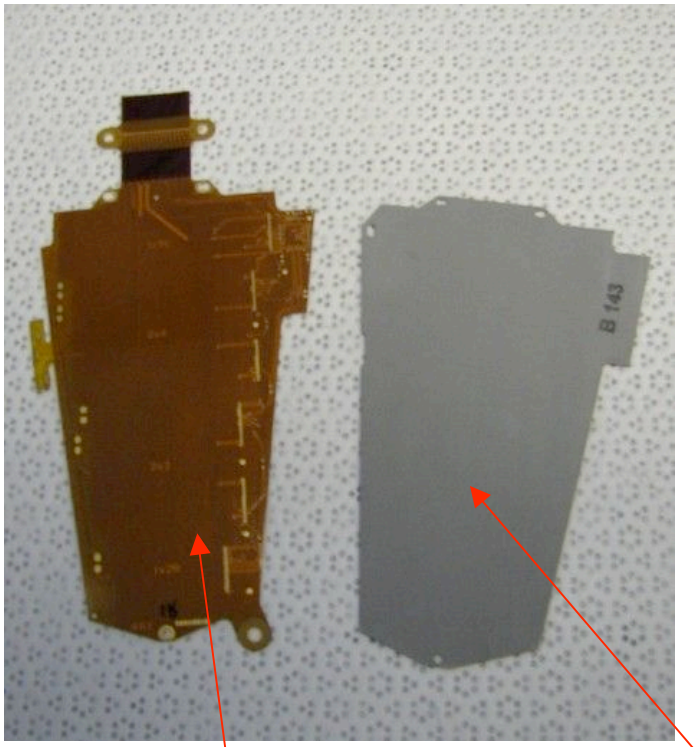
Black Pixel = very high threshold

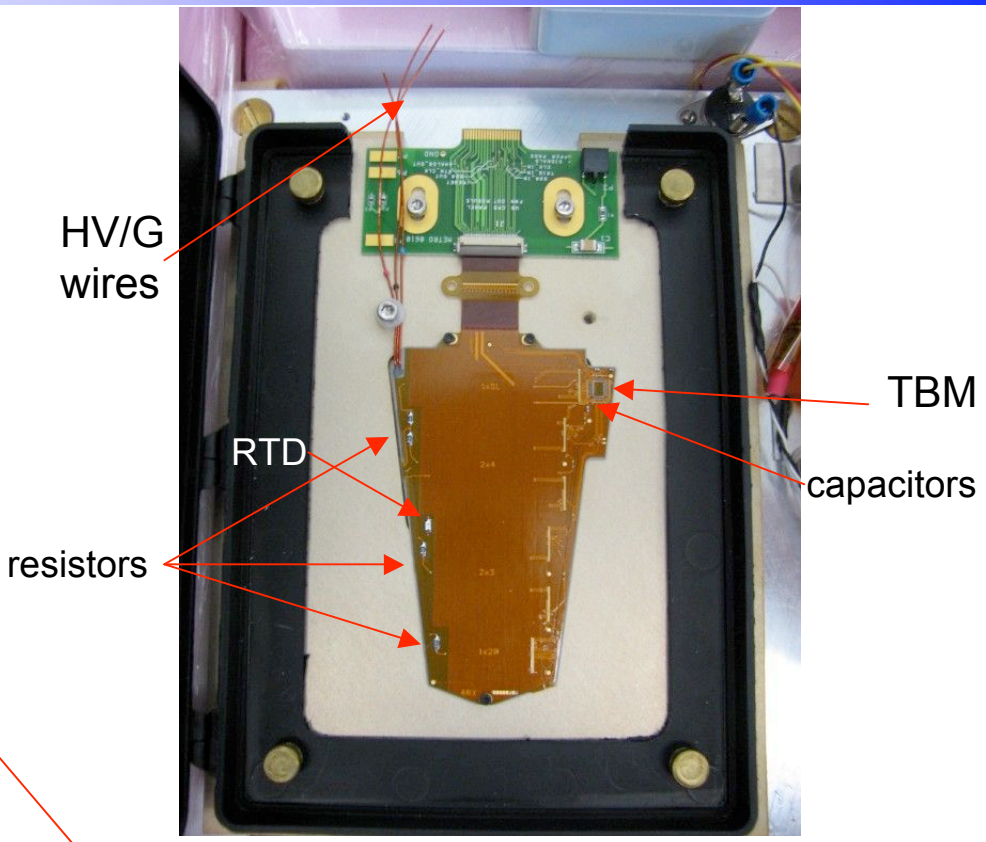
It is clearly evident the region of the ROC were the threshold of the pixels is much higher.

Plaquettes Summary

- We have alerted IZM to this problem and they are looking how to avoid the problem in the future.
  - Manufacturer is trying to rework a few selected plaquettes with that had only one of these ROCs.
- RTI has some issues with missing bump-bonds
  - Also working with them to improve quality
- IF all the “A” & “B” grade categories are usable
  - 15 blades worth of panels (2 panels/blade)
    - Roughly equal # of left and right given by 1xN L&R numbers.
  - One Half Disk needs 12 blades worth of panels
- However the “B”’s are still under group discussion

“Bare” Panel Production





“Bare” 4R$_{ight}$ Panel on Panel carrier

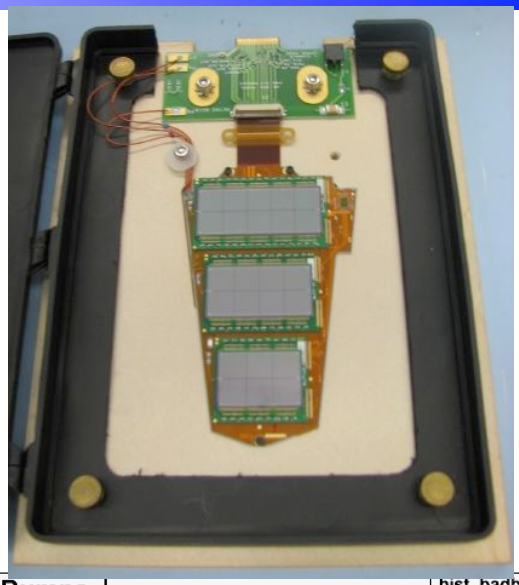
- Flex Circuit laminated to 500μ thick Be plate with 3M9882 (50 μ thick) Thermally Conductive Adhesive Tape
- Bare Panel = Populated (resistors, capacitors, RTD), Wires soldered, TBM attached, and wirebonded

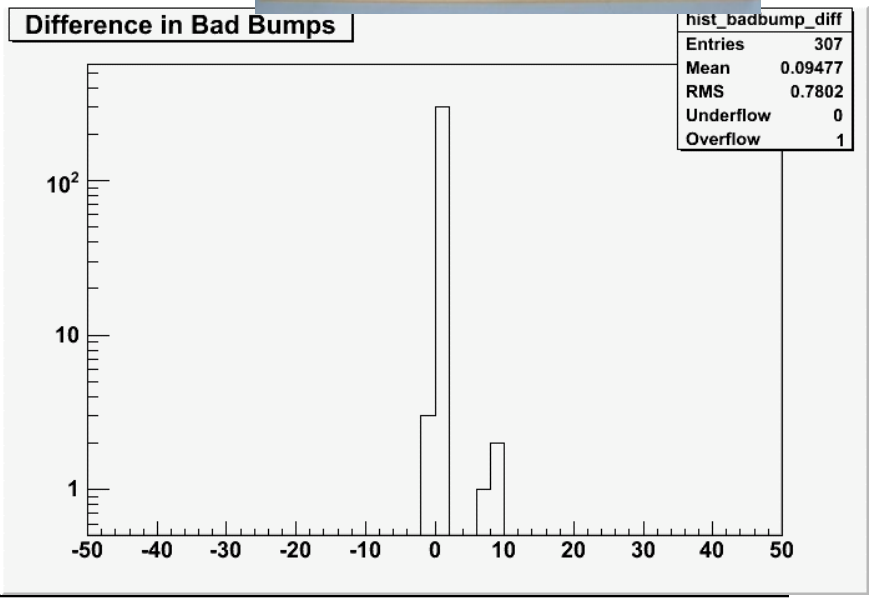
Bare Panel Yields

	4R	3R
Manufacturer Defects	20	7
Production failures	9	14
Test&2007 Detector	4	5
Production	37	44
Sum	70	70
Needed for full Production/Spare	55	55
deficit	18	11

Full Panel Production Inventory

- Eight 2007 Pilot Run Panels
  - Plaquettes taken (primarily) from preproduction plaquettes
  - Four 3R and four 4R types
- Full Production Panels
  - Six good 3R Panels
    - (one damaged during production)
  - Seven good 4R Panels
  - We pick up a few more bad bumps on the RTI plaquettes after panel building
    - These are typically in corners of plaquettes which already had some bad bumps





Assemble and leak test HalfDisk Parts

½-Disk

Cooling Channels for Disks on -z

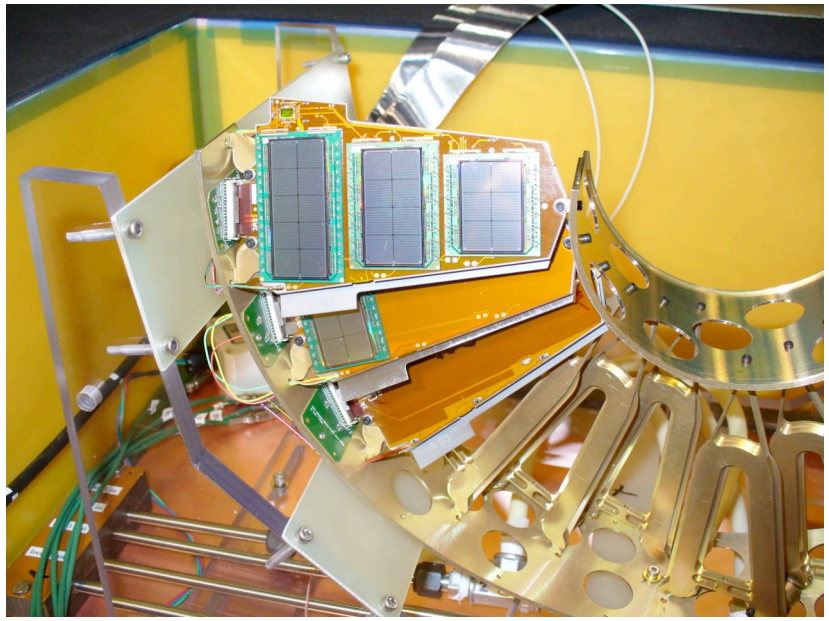
Need 8

Need 2

Need 2

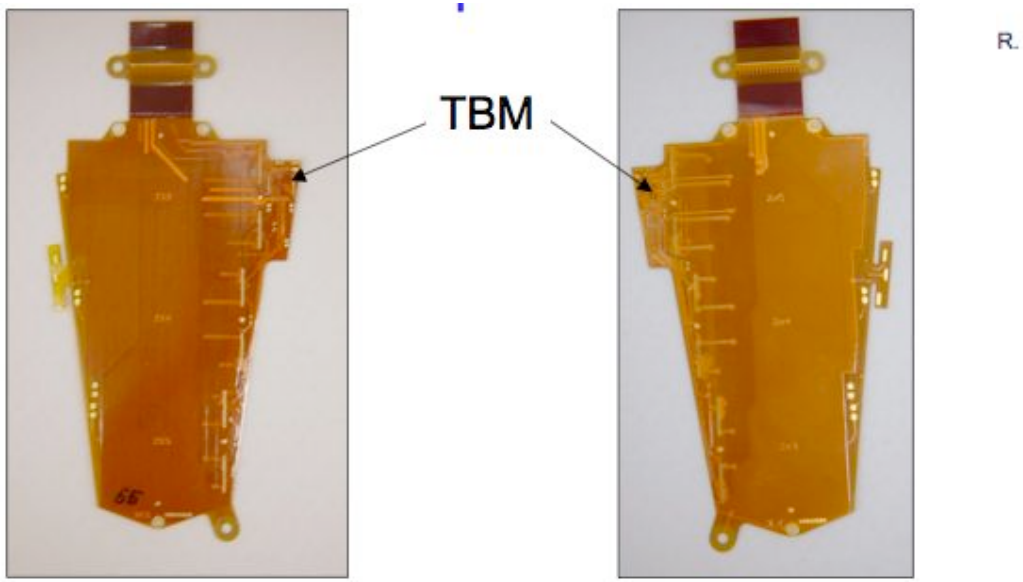
Mount and Test Panels on Half-Disk Assembly

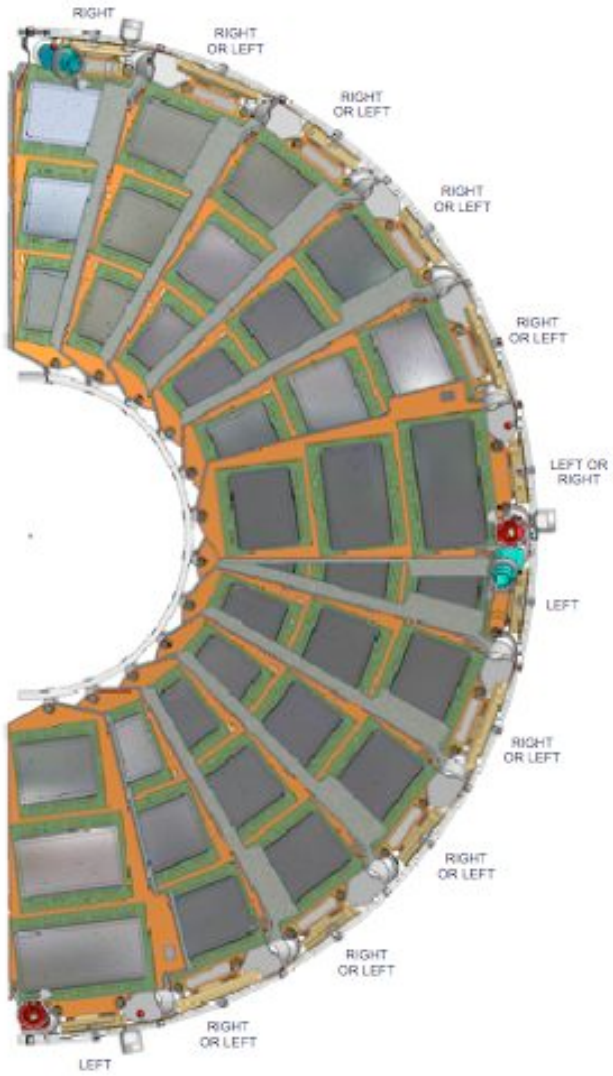
- Mechanics (-Z HD) should be ready end of October for first Half-Disk
- Need 24 panels
  - Currently
  - At least two 3L and two 4L Panels
    - Left HDI availability?
  - Four more 3(L or R) and three more 4(L or R) panels
    - Plaquettes to put on



Panel Production Schedule Implications

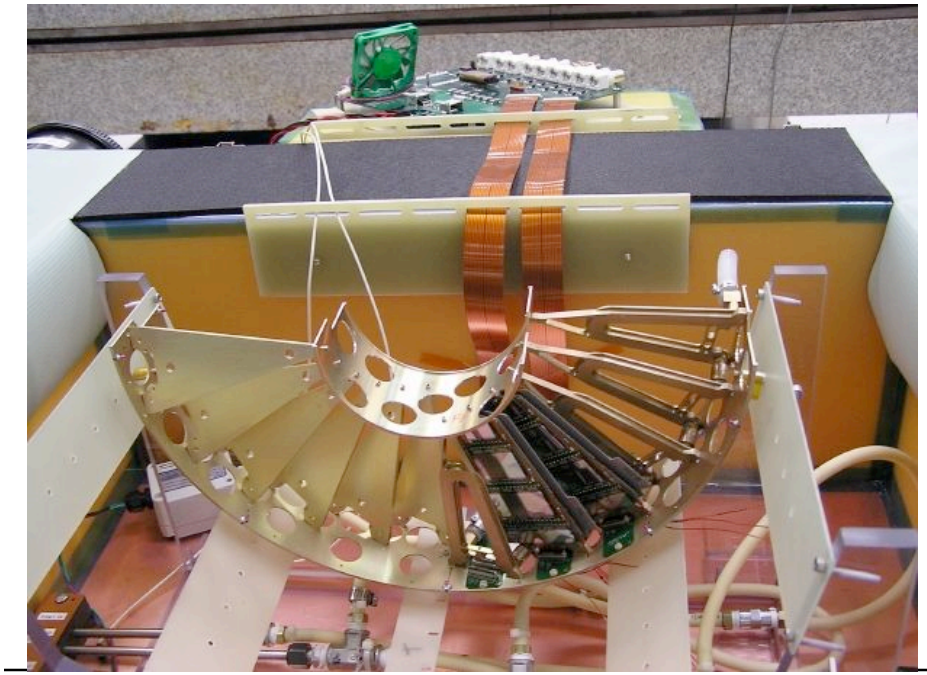
- Panels needed for first Half Disks ("-Z")
  - See Doc 583 G. Derylo
  - Must have <u>at least</u> two 3L, two 4L panels, one 3R, and one 4R
  - Remainder can be either R or L

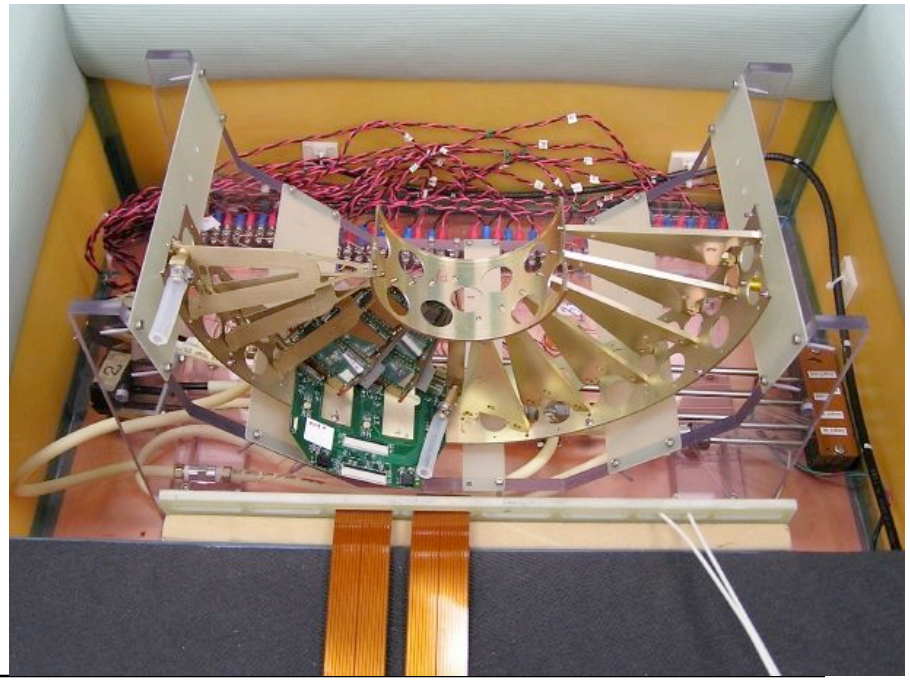




2007 Pilot Run HalfDisk Assembly

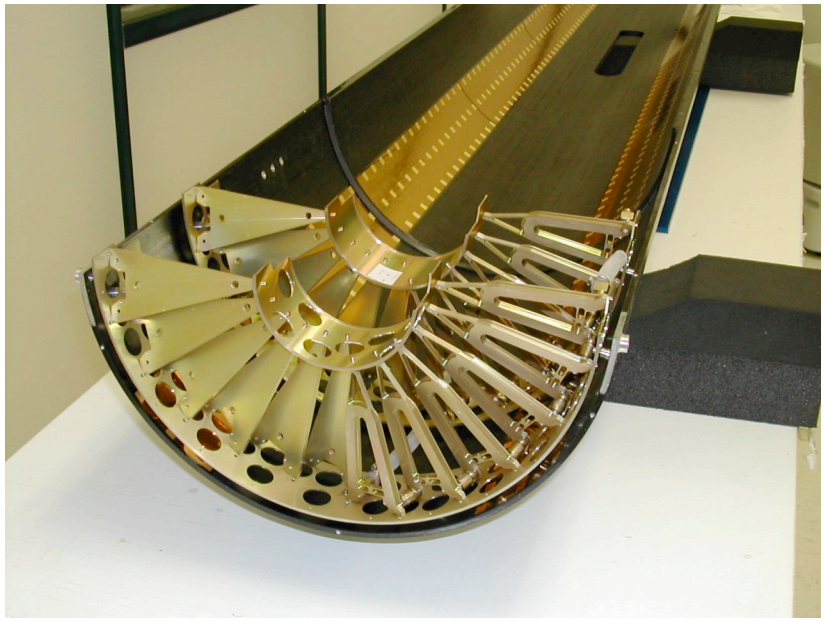
- 2007 Pilot Run Panels are ready (8 total)
- All are now mounted onto the two 2007 Half-Disks
  - Cooling and electrical tests underway
- < 2 hrs to mount 4 panels on 2nd Half-Disk
  - ~1 day to mount 24 panels on Production Detector
- Plan for Pilot run Detector to be completed end of November 06 and shipped to Tracker Integration Facility at CERN

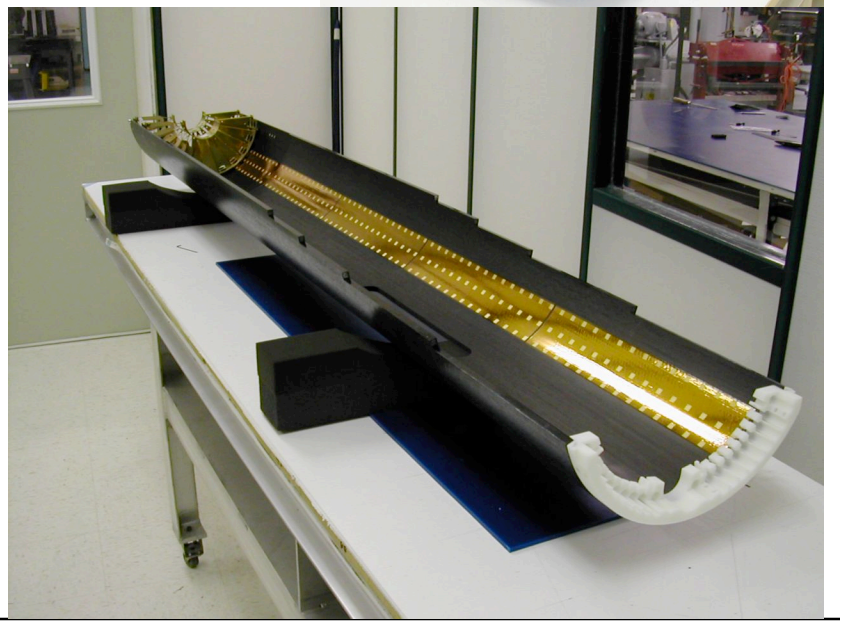




Mount support electronics and half Disks into 1/2 Service Cylinder

•2007 Pilot Run Detector Half-Disk Mechanics



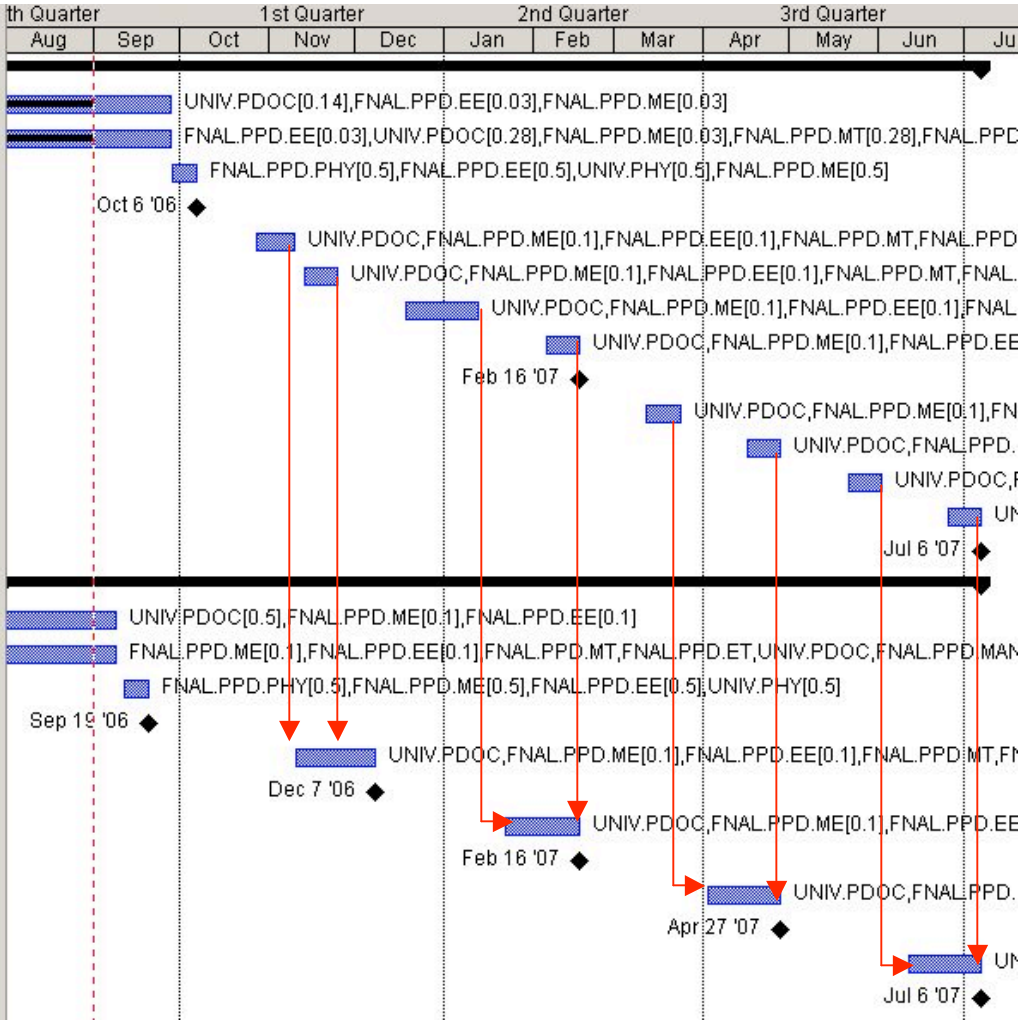


Final Detector Assembly

- Final detector assembly in Lab C at SiDET.
  - Assembling cooling channels into Half-Disks
    - First production finished end of October 06
  - Placing panels on Half-Disks
    - Quick functionality tests
  - Mounting support electronics and cooling into 1/2 service cylinders.
  - Mount Half Disks into 1/2 Service Cylinder #1
    - ~early December 06-January 07
  - Commissioning @ SiDET
  - Shipping to CERN (TIF) end Jan 07
  - Will ship remaining three 1/2 service cylinders @ one every 2 months

Final Assembly Schedule (from Aug.06)

	MSPrj Cost
Mount Panels onto the Half-Disk	**$101,012.07**
Requirements, Specifications, Procedures for Ha	$3,503.27
H_D Preproduction	$26,223.56
Production Readiness Review: Mounting Panels	$4,087.16
Ready for Mounting Panels onto Half-Disk	$0.00
H_D Final Assembly #1	$8,399.76
H_D Final Assembly #2	$8,399.76
H_D Final Assembly #3	$8,399.76
H_D Final Assembly #4	$8,399.76
4 Half Disks Completed	$0.00
H_D Final Assembly #5	$8,399.76
H_D Final Assembly #6	$8,399.76
H_D Final Assembly #7	$8,399.76
H_D Final Assembly #8	$8,399.76
All Half Disks Completed	$0.00
Mount Half-Disks (etc.) onto the 1/2 Service Cylinde	**$79,316.09**
Requirements, Specifications, Procedures for 1/2	$3,503.28
1/2 Service Cylinder Pre-production	$26,223.57
Production Readiness Review: Installing Half-Dis	$4,087.16
Ready for Installing Half-Disks into 1/2 Service Cy	$0.00
1/2 Service Cylinder #1	$16,799.52
1/2 Service Cylinder 1 Ready	$0.00
1/2 Service Cylinder #2	$9,567.52
1/2 Service Cylinder 2 Ready	$0.00
1/2 Service Cylinder #3	$9,567.52
1/2 Service Cylinder 3 Ready	$0.00
1/2 Service Cylinder #4	$9,567.52
1/2 Service Cylinder 4 Ready	$0.00



Gaps are set by Plaquette Production rates and scheduling (wait to make panels until all plaquettes for that panel's HD are tested). This gives some more schedule float.

Summary

- All Production steps thru Panel Testing have begun and produced parts.
  - Issues with bump bonding have been identified and manufacturers alerted to problem.
  - QC of production line needs vigilence
- Pilot 2007 Detector Panels have been Mounted on Half-Disks
- Expect production panel mounting onto HD late October 06
- First Half-Disk assembly with panels Nov 06
  - Roughly produce one Half-Disk/month (8 total)
- First Production Complete 1/2 Service Cylinder shipped to TIF in late Jan 07.

Summary- ManPower Issues

- We are now peaking in manpower as the production pipeline is filled
  - People have all been identified and are on board
  - Main effort (engineers and senior techs) occurs at beginning of each new step as we solve initial setup problems
  - Production manpower needs are beginning to wind down
    - Labor intensive work (VHDI/HDI laminations, visual inspections…..) are coming to an end in the next few months
      - (some redo's)
    - Final assembly is with fewer number of parts
      - 672 Plaquettes->192 Panels->8 Half-Disks->4 Half-Cylinders
- Most testing is done with University and FNAL Physicists.